PHYS 541 Radiative Processes

Spring 2015 Syllabus

Class website: http://spacibm.rice.edu/~liang/phys541/

Instructor: Edison Liang, Room 342 Herman Brown Hall, x3524, email: liang@rice.edu

Office Hours: MW 2 – 4 pm and TuTh 12:10 – 1 pm except when instructor is in meetings.

Class Time: TuTh 10:50 AM – 12:05 PM; Class Room: 254 Herman Brown Hall

Main Text:
Radiative Processes in Astrophysics, by George Rybicki and Alan Lightman (2004, Wiley paperback)

Supplemental References: (Items 1 - 6 have been put on reserve in Fondren Library. Some items are also available in HBH 3rd floor Reading Room)
1. Classical Theory of Fields, L. Landau & E. Lifshitz (Oxford)
2. Radiative Processes in Plasmas, G. Bekefi (Wiley)
3. The Physics of Astrophysics Vol.1: Radiation, F. Shu (University Science Books)
4. Radiation Processes in Astrophysics, W. Tucker (MIT)
5. Electromagnetic Processes , R. Gould (Princeton)
6. Quantum Theory of Radiation, W. Heitler (Dover)
7. Radiation in Astrophysical Plasmas, V. Zheleznyakov (Kluwer)
8. Principle of Lasers, O. Svelto & D. Hanna (Plenum)

Grades : 50% Home works, 50% Final Project.
Home works are normally due 2 weeks after their assignment. Late home works will be discounted 25% for each lecture it is late, except for special hardship cases. Solutions will be posted on class website after home works are graded.
Grader: Joe Barchas, x2653, email: joe.barchas @rice.edu

Rice Honor Code: Students are expected to uphold the Rice Honor Code. Students can discuss home works together, but should avoid turning in identical home works.

Course Objectives: This is a course on the physics of electromagnetic radiation processes. It has broad and important applications to all branches of physics, from astrophysics to nuclear and particle physics, AMO and medical physics. While the core material is based on the textbook by Rybicki and Lightman, I plan to slightly reduce the mathematical rigor and lengthy derivations of classical electromagnetic theory of the text, and increase discussions of quantum radiation processes, including stimulated emission processes relevant to laser physics. I also plan to expand the applications from rarified plasmas to the interaction of radiation with neutral and condensed matter. Finally, I have reserved up to two lectures for selective topics to be mutually decided by the students and instructor.

Learning Outcomes: Students are expected to turn in home works every two weeks, which will be graded, and complete a Final project. Students will acquire knowledge in all areas of classical and quantum radiative processes, both relativistic and nonrelativistic. Though home works, student will become fluent in solving problems in all areas of radiation physics, from the radiative transfer equations, to atomic and molecule emission and absorption processes. Students will acquire analytical and numerical problem solving skills. In the Final project, students are expected to write a comprehensive review on a current research topic to be chosen by the student and instructor, based on material in the published literature.

Any student with a documented disability that requires accommodation should contact both the course instructor and Disability Support Services in the Allen Center.

Tentative Topics and Number of Lectures

TOPIC	TENTATIVE NO. OF LECTURES	R & L Chapter
Introduction & organization		
Radiative transfer	2	1
Thermal radiation, diffusion, Einstein coefficients	1	1
Radiation Fields, polarization, Stokes parameters	2	2
Radiation from moving charges	2	3
Special Relativity	2	4
Bremsstrahlung (free-free) radiation	2	5
Synchrotron radiation	2	6
Thomson & Compton scattering	3	7
Pairs & high energy processes	1	
Plasma and other medium effects	1	8
Atomic structure	2	9
Radiative transitions, Rayleigh scattering	3	10
Molecular structure	1	11
Stimulated emission, coherent radiation	1	
Other optional topics (TBD)	2	